Huawei Technologies Co.,Ltd

TEST REPORT

SCOPE OF WORK
FCC TESTING–CM70-C

REPORT NUMBER
SZHH01324725-002

ISSUE DATE	**[REVISED DATE]**
March 21, 2019	[----------]

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TEST REPORT

Intertek Report No.: SZHH01324725-002

Huawei Technologies Co.,Ltd

Application
For
Certification

FCC ID: QISCM70-C

HUAWEI Wireless Earphone

Model: CM70-C

Brand Name: HUAWEI

2.4GHz Transceiver

Report No.: SZHH01324725-002

We hereby certify that the sample of the above item is considered to comply with the requirements of FCC Part 15, Subpart C for Intentional Radiator, mention 47 CFR [10-1-17]

Prepared and Checked by:

Sign on file

Terry Tang
Senior Engineer

Approved by:

Kidd Yang
Technical Supervisor
Date: March 21, 2019

LIST OF EXHIBITS

MEASUREMENT/TECHNICAL REPORT

Huawei Technologies Co.,Ltd

Model: CM70-C

FCC ID: QISCM70-C

This report concerns (check one:) Original Grant __X__ Class I Change _

Equipment Type: DSS - Part 15 Spread Spectrum Transmitter

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? Yes _____ No __X__

If yes, defer until: _____
date

Company Name agrees to notify the Commission by: _____
date

of the intended date of announcement of the product so that the grant can be issued on that date.

Transition Rules Request per 15.37? Yes _____ No __X__

If no, assumed Part 15, Subpart C for intentional radiator – the new 47 CFR [10-1-17 Edition] provision.

Report prepared by:

Terry Tang
Intertek Testing Services Shenzhen Ltd. Longhua Branch
101, 201, Building B, No. 308 Wuhe Avenue, Zhangkengjing
Community, GuanHu Subdistrict, LongHua District, Shenzhen.
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Exhibit type	File Description	filename
Test Report	Test Report	report.pdf
Operational Description	Technical Description	descri.pdf
Test Setup Photo	Radiated Emission	radiated photos.pdf
External Photos	External Photo	external photos.pdf
Internal Photos	Internal Photo	internal photos.pdf
ID Label/Location Info	Label Artwork and Location	label.pdf
Block Diagram	Block Diagram	block.pdf
Schematics	Circuit Diagram	circuit.pdf
Users Manual	User Manual	manual.pdf
Cover Letter	Letter of Agency	agency.pdf
Cover Letter	Confidentiality Letter	request.pdf

EXHIBIT 1

GENERAL DESCRIPTION

1.0 General Description

1.1 Product Description

The equipment under test (EUT) is a HUAWEI Wireless Earphone with Bluetooth functions operating in 2402-2480MHz. The EUT is powered by DC 3.7V(1 x 3.7V rechargeable battery) and the Bluetooth function can't operation during charging. For more detail information pls. refer to the user manual.

Bluetooth Version: 5.0
Antenna Type: Integral antenna
Antenna Gain: 0 dBi
Modulation Type: GFSK, π/4-DQPSK and 8-DPSK

For electronic filing, the brief circuit description is saved with filename: descri.pdf.

1.2 Related Submittal(s) Grants

This is an application for certification of transceiver for the HUAWEI Wireless Earphone which has Bluetooth function. The BLE function was reported in the test report: SZHH01324725-001.

1.3 Test Methodology

Radiated emission measurements was performed according to the procedures in ANSI C63.10 (2013) and KDB 558074 D01 v05r01. Radiated emission measurement was performed in semi-anechoic chamber and conducted emission measurement was performed in shield room. For radiated emission measurement, preliminary scans were performed in the semi-anechoic chamber only to determine the worst case modes. All radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Justification Section**" of this Application.

1.4 Test Facility

The Semi-anechoic chamber used to collect the radiated data is **Intertek Testing Services Shenzhen Ltd. Longhua Branch** and located at 101, 201, Building B, No. 308 Wuhe Avenue, Zhangkengjing Community, GuanHu Subdistrict, LongHua District, Shenzhen. This test facility and site measurement data have been fully placed on file with File Number: CN1188.

EXHIBIT 2

SYSTEM TEST CONFIGURATION

2.0 System Test Configuration

2.1 Justification

The system was configured for testing in a typical fashion (as a customer would normally use it), and in the confines as outlined in ANSI C63.10 (2013).

The EUT was powered by DC 3.7V(1 x 3.7V rechargeable battery) during the test. Only the worst case data was reported.

All packets DH1, DH3 & DH5 mode in modulation type GFSK, π/4-DQPSK and 8-DPSK were tested and only the worst data was reported in this report.

For maximizing emissions below 30 MHz, the EUT was rotated through 360°, the centre of the loop antenna was placed 1 meter above the ground, and the antenna polarization was changed. For maximizing emissions, the EUT was rotated through 360°, the antenna height was varied from 1 meter to 4 meters above the ground plane, and the antenna polarization was changed. This step by step procedure for maximizing emissions led to the data reported in Exhibit 3.0.

The EUT was operated standalone and placed in the central of the turntable.

The equipment under test (EUT) was configured for testing in a typical fashion (as a customer would normally use it). The EUT was placed on a turn table, which enabled the engineer to maximize emissions through its placement in the three orthogonal axes.

2.2 EUT Exercising Software

The EUT exercise program (provided by client) used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use. The worst case configuration is used in all specified testing.

The parameters of test software setting:
During the test, Channel and power controlling software provided by the applicant was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the application and is going to be fixed on the firmware of the end product.

2.3 Special Accessories

No special accessory attached.

2.4 Equipment Modification

Any modifications installed previous to testing by Huawei Technologies Co.,Ltd will be incorporated in each production model sold / leased in the United States.

No modifications were installed by Intertek Testing Services Shenzhen Ltd. Longhua Branch.

2.5 Measurement Uncertainty

When determining the test conclusion, the Measurement Uncertainty of test has been considered.

2.6 Support Equipment List and Description

Description	Manufacturer	Model No.
Mobile Phone (Provided by Intertek)	HUAWEI	HMA-AL00

EXHIBIT 3

TEST RESULTS

3.0 Test Results

Data is included worst-case configuration (the configuration which resulted in the highest emission levels).

3.1 Radiated Test Results

A sample calculation, configuration photographs and data tables of the emissions are included.

3.1.1 Field Strength Calculation

The field strength is calculated by adding the reading on the Spectrum Analyzer to the factors associated with preamplifiers (if any), antennas, cables, pulse desensitization and average factors (when specified limit is in average and measurements are made with peak detectors). A sample calculation is included below.

FS = RA + AF + CF - AG + PD + AV

Where FS = Field Strength in dBµV/m
RA = Receiver Amplitude (including preamplifier) in dBµV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB
PD = Pulse Desensitization in dB
AV = Average Factor in -dB

In the radiated emission table which follows, the reading shown on the data table may reflect the preamplifier gain. An example of the calculations, where the reading does not reflect the preamplifier gain, follows:

FS = RA + AF + CF - AG + PD + AV

Assume a receiver reading of 62.0 dBµV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted. The pulse desensitization factor of the spectrum analyzer was 0 dB, and the resultant average factor was -10 dB. The net field strength for comparison to the appropriate emission limit is 32 dBµV/m. This value in dBµV/m was converted to its corresponding level in µV/m.

RA = 62.0 dBµV
AF = 7.4 dB
CF = 1.6 dB
AG = 29.0 dB
PD = 0 dB

AV = -10 dB

FS = 62 + 7.4 + 1.6 - 29 + 0 + (-10) = 32 dBµV/m

Level in µV/m = Common Antilogarithm [(32 dBµV/m)/20] = 39.8 µV/m

3.1.2 Radiated Emission Configuration Photograph

For electronic filing, the worst case radiated emission configuration photograph is saved with filename: radiated photos. pdf.

3.1.3 Radiated Emissions- FCC section 15.209

The data on the following page lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

Worst Case Radiated Emission

at 951.985 MHz

Judgement: Passed by 13.4 dB

TEST PERSONNEL:

Sign on file

Terry Tang, Senior Engineer
Typed/Printed Name

March 19, 2019
Date

Applicant: Huawei Technologies Co.,Ltd
Date of Test: March 19, 2019
Model: CM70-C
Worst-case operating Mode: BT link
Modulation type: GFSK

Table 1

Radiated Emissions

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBµV/m)	Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	31.940	30.8	20.0	10.1	20.9	40.0	-19.1
Horizontal	386.960	22.6	20.0	19.3	21.9	46.0	-24.1
Horizontal	531.005	24.9	20.0	21.1	26.0	46.0	-20.0
Horizontal	700.270	28.0	20.0	21.5	29.5	46.0	-16.5
Horizontal	836.555	28.6	20.0	21.6	30.2	46.0	-15.8
Horizontal	960.230	30.7	20.0	21.7	32.4	54.0	-21.6
Vertical	32.425	31.6	20.0	10.1	21.7	40.0	-18.3
Vertical	37.275	27.0	20.0	11.3	18.3	40.0	-21.7
Vertical	299.175	20.4	20.0	18.7	19.1	46.0	-26.9
Vertical	715.305	29.0	20.0	20.1	29.1	46.0	-16.9
Vertical	824.915	28.7	20.0	21.6	30.3	46.0	-15.7
Vertical	951.985	30.9	20.0	21.7	32.6	46.0	-13.4

NOTES:
1. Quasi-Peak detector is used except for others stated.
2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
3. Negative value in the margin column shows emission below limit.
4. All emissions are below the QP limit.

3.1.4 Transmitter Spurious Emissions (Radiated) - FCC section 15.209

The data on the following page lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

Worst Case Radiated Emission

at 7440.000 MHz

Judgement: Passed by 18.1 dB

TEST PERSONNEL:

Sign on file

Terry Tang, Senior Engineer
Typed/Printed Name

March 19, 2019
Date

Applicant: Huawei Technologies Co.,Ltd
Date of Test: March 19, 2019
Model: CM70-C
Worst-case operating Mode: Transmit (2402MHz)
Modulation type: 8-DPSK

Table 2
Radiated Emissions
(2402 MHz)

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	2402.000	109.7	36.7	28.1	101.1	--	--
Horizontal	4804.000	49.0	36.7	35.5	47.8	74.0	-26.2
Horizontal	7206.000	55.1	36.1	36.5	55.5	74.0	-18.5
Horizontal	2383.000	50.7	36.5	28.1	42.3	74.0	-31.7

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Average Factor (-dB)	Net at 3m (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	2402.000	109.7	36.7	28.1	22.5	78.6	--	--
Horizontal	4804.000	49.0	36.7	35.5	22.5	25.3	54.0	-28.7
Horizontal	7206.000	55.1	36.1	36.5	22.5	33.0	54.0	-21.0
Horizontal	2383.000	50.7	36.5	28.1	22.5	19.8	54.0	-34.2

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
Vertical	2402.000	102.1	36.7	28.1	93.5	--	--
Vertical	4804.000	47.3	36.7	35.5	46.1	74.0	-27.9
Vertical	7206.000	53.6	36.1	36.5	54.0	74.0	-20.0
Vertical	2383.000	48.6	36.5	28.1	40.2	74.0	-33.8

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Average Factor (-dB)	Net at 3m (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
Vertical	2402.000	102.1	36.7	28.1	22.5	71.0	--	--
Vertical	4804.000	47.3	36.7	35.5	22.5	23.6	54.0	-30.4
Vertical	7206.000	53.6	36.1	36.5	22.5	31.5	54.0	-22.5
Vertical	2383.000	48.6	36.5	28.1	22.5	17.7	54.0	-36.3

Notes:
1. Peak Detector Data unless otherwise stated.
2. All measurements were made at 3 meter. Harmonic emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
3. Negative value in the margin column shows emission below limit.
4. Horn antenna is used for the emission over 1000MHz.

Applicant: Huawei Technologies Co.,Ltd
Date of Test: March 19, 2019
Model: CM70-C
Worst-case operating Mode: Transmit (2441MHz)
Modulation type: 8-DPSK

Table 3
Radiated Emissions
(2441 MHz)

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	2441.000	110.4	36.7	28.1	101.8	--	--
Horizontal	4882.000	50.4	36.3	33.5	47.6	74.0	-26.4
Horizontal	7323.000	54.0	36.3	37.7	55.4	74.0	-18.6

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Average Factor (-dB)	Net at 3m (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	2441.000	110.4	36.7	28.1	22.5	79.3	--	--
Horizontal	4882.000	50.4	36.3	33.5	22.5	25.1	54.0	-28.9
Horizontal	7323.000	54.0	36.3	37.7	22.5	32.9	54.0	-21.1

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
Vertical	2441.000	103.1	36.7	28.1	94.5	--	--
Vertical	4882.000	49.7	36.3	33.5	46.9	74.0	-27.1
Vertical	7323.000	52.8	36.3	37.7	54.2	74.0	-19.8

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Average Factor (-dB)	Net at 3m (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
Vertical	2441.000	103.1	36.7	28.1	22.5	72.0	--	--
Vertical	4882.000	49.7	36.3	33.5	22.5	24.4	54.0	-29.6
Vertical	7323.000	52.8	36.3	37.7	22.5	31.7	54.0	-22.3

Notes:
1. Peak Detector Data unless otherwise stated.
2. All measurements were made at 3 meter. Harmonic emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
3. Negative value in the margin column shows emission below limit.
4. Horn antenna is used for the emission over 1000MHz.

Applicant: Huawei Technologies Co.,Ltd
Date of Test: March 19, 2019
Model: CM70-C
Worst-case operating Mode: Transmit (2480MHz)
Modulation type: 8-DPSK

Table 4
Radiated Emissions
(2480 MHz)

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	2480.000	108.5	36.7	28.1	99.9	--	--
Horizontal	4960.000	50.3	36.3	33.5	47.5	74.0	-26.5
Horizontal	7440.000	54.4	36.3	37.8	55.9	74.0	-18.1
Horizontal	2485.000	46.7	36.1	28.2	38.8	74	-35.2

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Average Factor (-dB)	Net at 3m (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	2480.000	108.5	36.7	28.1	22.5	77.4	--	--
Horizontal	4960.000	50.3	36.3	33.5	22.5	25.0	54.0	-29.0
Horizontal	7440.000	54.4	36.3	37.8	22.5	33.4	54.0	-20.6
Horizontal	2485.000	46.7	36.1	28.2	22.5	16.3	54.0	-37.7

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
Vertical	2480.000	103.4	36.7	28.1	94.8	--	--
Vertical	4960.000	48.9	36.3	33.5	46.1	74.0	-27.9
Vertical	7440.000	52.3	36.3	37.8	53.8	74.0	-20.2
Vertical	2485.000	45.8	36.1	28.2	37.9	74	-36.1

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Average Factor (-dB)	Net at 3m (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
Vertical	2480.000	103.4	36.7	28.1	22.5	72.3	--	--
Vertical	4960.000	48.9	36.3	33.5	22.5	23.6	54.0	-30.4
Vertical	7440.000	52.3	36.3	37.8	22.5	31.3	54.0	-22.7
Vertical	2485.000	45.8	36.1	28.2	22.5	15.4	54.0	-38.6

Notes:
1. Peak Detector Data unless otherwise stated.
2. All measurements were made at 3 meter. Harmonic emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
3. Negative value in the margin column shows emission below limit.
4. Horn antenna is used for the emission over 1000MHz.

3.2 Peak Power

Maximum Conducted Output Power at Antenna Terminals, FCC Rules 15.247(b)(1).
The antenna port of the EUT was connected to the input of a spectrum analyzer. The analyzer was set for RBW > 20dB bandwidth and power was read directly in dBm.

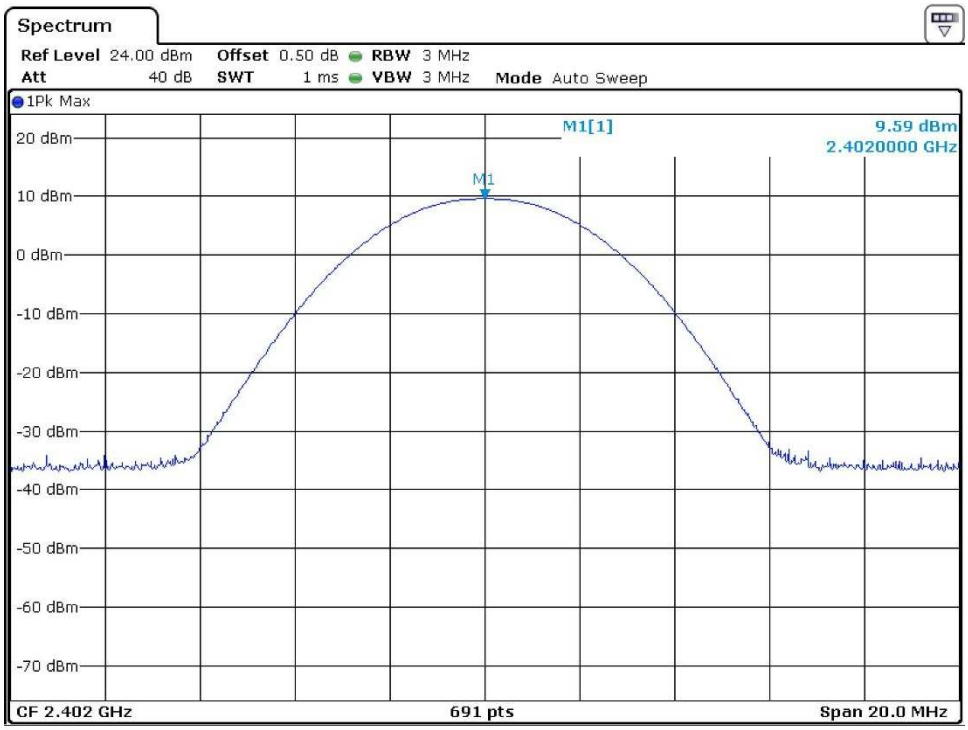
For antenna with gains of 6dBi or less, and frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, the systems operate with an output power no greater than 125 mW.

Antenna Gain = 0dBi			
Modulation Type	Frequency (MHz)	Output Power (Peak Reading) (dBm)	Output Power (mW)
8-DPSK	2402	9.59	9.099
	2441	9.77	9.484
	2480	9.52	8.954

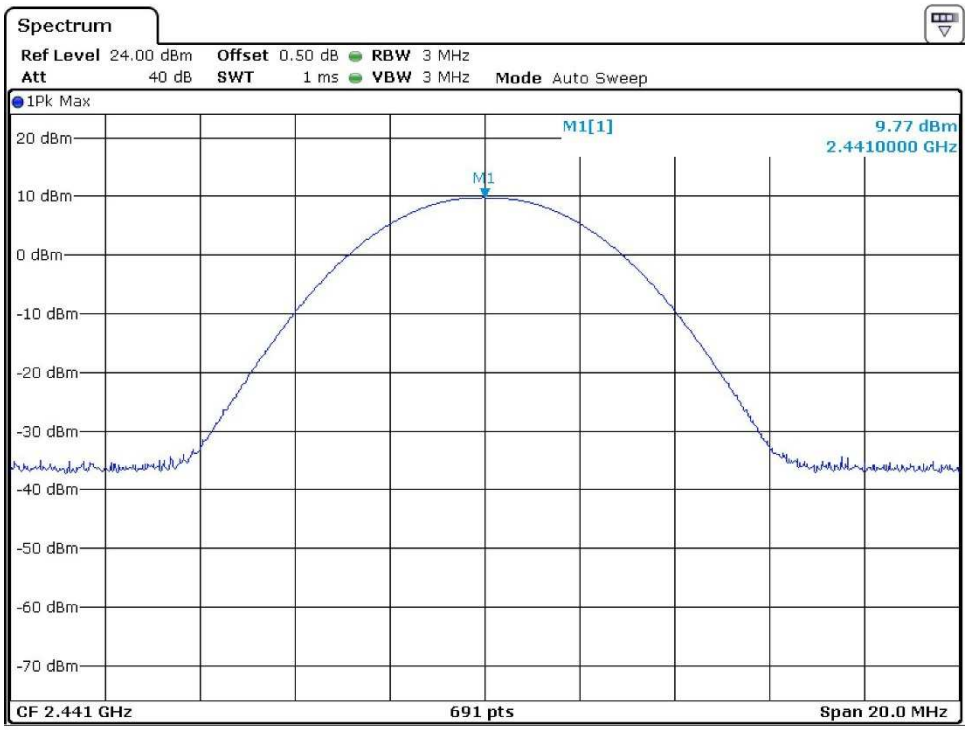
Cable loss: 0.5 dB External Attenuation: 0 dB

Modulation Type: 8-DPSK

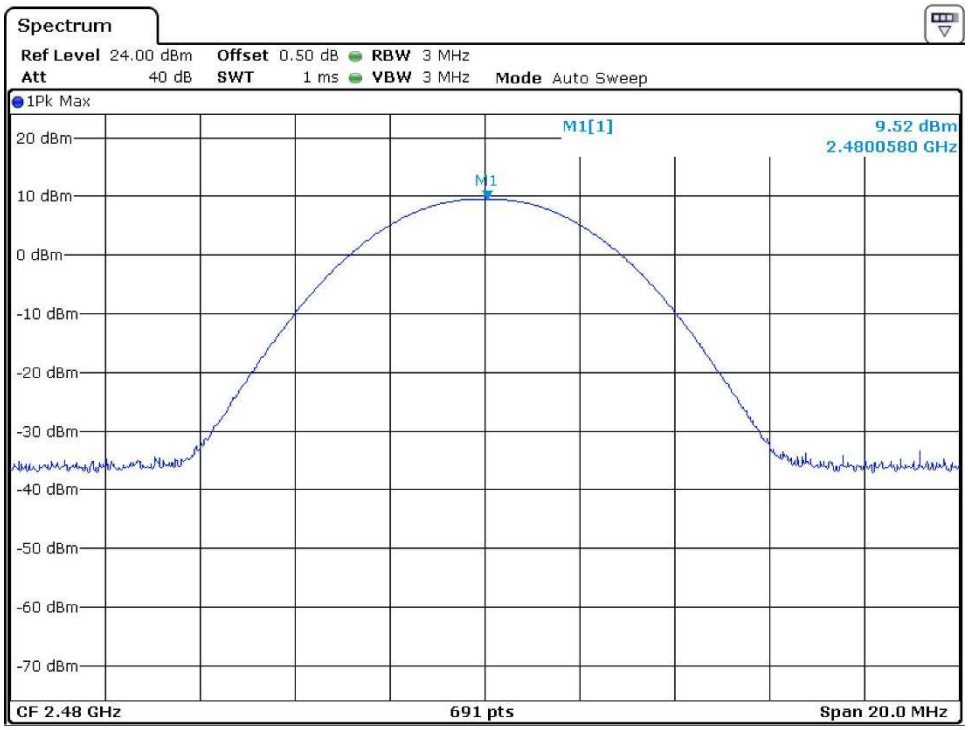
CH00



CH39



CH78


Spectrum
Ref Level 24.00 dBm Offset 0.50 dB RBW 3 MHz
Att 40 dB SWT 1 ms VBW 3 MHz Mode Auto Sweep
1Pk Max
M1[1] 9.52 dBm
2.4800580 GHz
M1
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.48 GHz
691 pts
Span 20.0 MHz

3.3 20dB Bandwidth

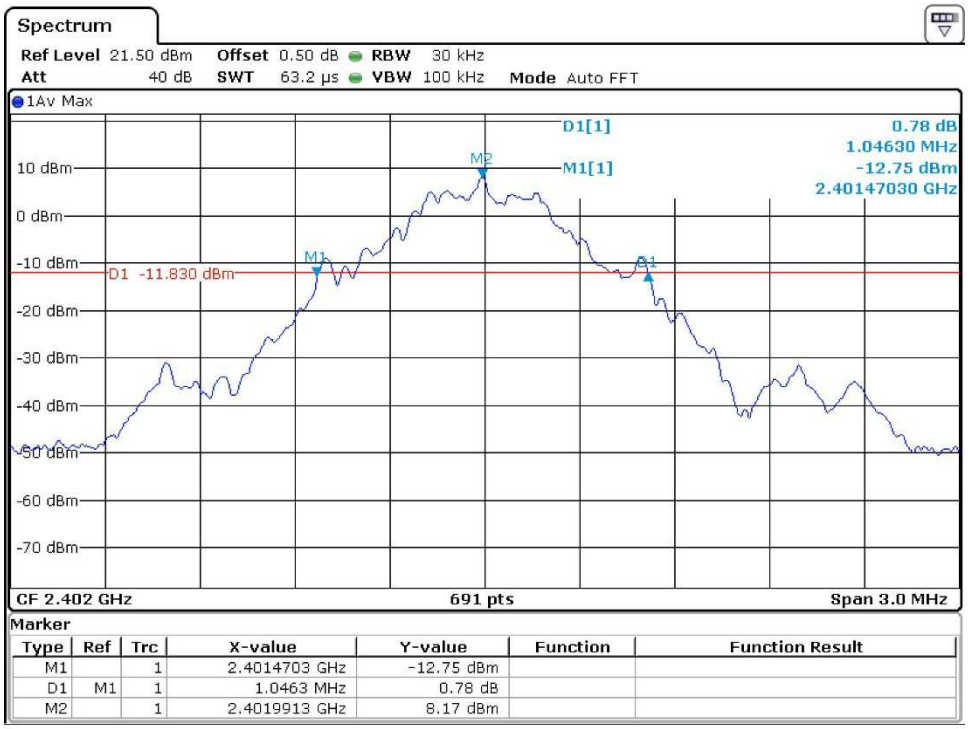
Maximum 20dB RF Bandwidth, FCC Rule 15.247(a) (1):

The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer RBW was chosen so that the display was a result of the hopping channel modulation. For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. Use the spectrum 20dB down delta function to measure the bandwidth.

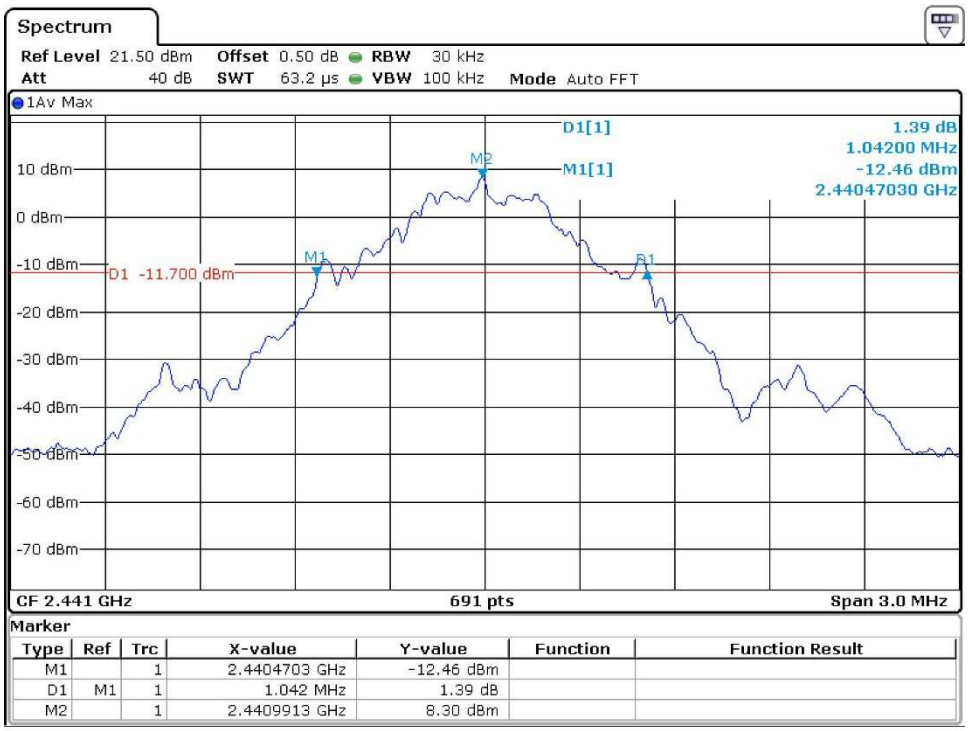
Frequency (MHz)	20 dB Bandwidth (MHz)
2402	1.046
2441	1.042
2480	1.042

Modulation Type: GFSK

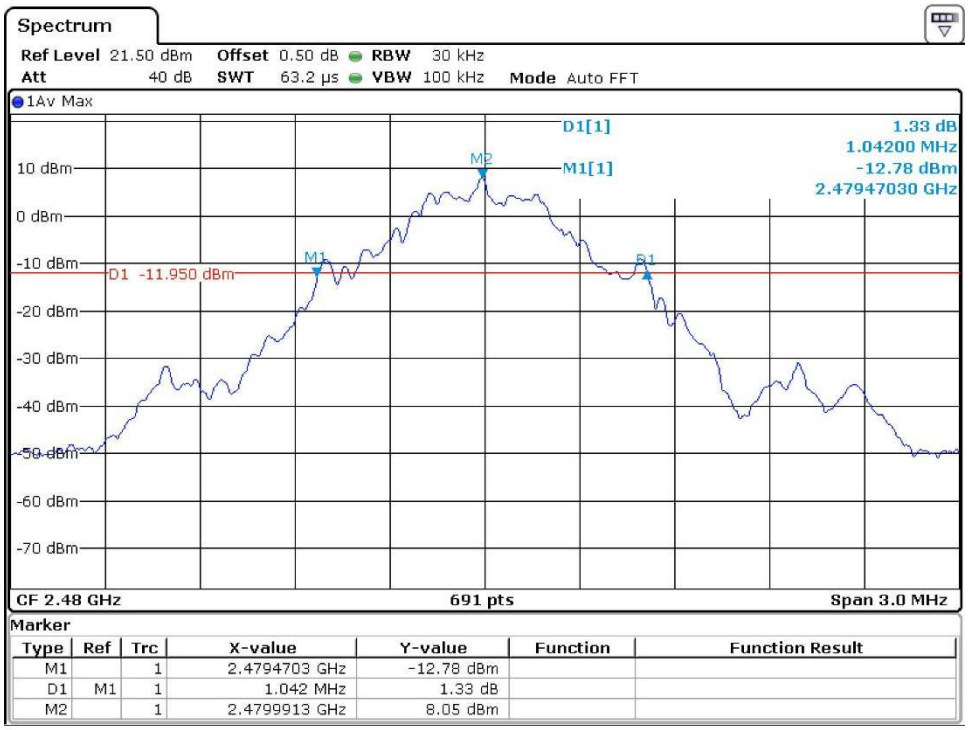
CH00



CH39


Spectrum
Ref Level 21.50 dBm Offset 0.50 dB RBW 30 kHz
Att 40 dB SWT 63.2 µs VBW 100 kHz Mode Auto FFT
1Av Max
D1[1] 1.39 dB
1.04200 MHz
M1[1] -12.46 dBm
2.44047030 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
D1 -11.700 dBm
M1
M2
B1
CF 2.441 GHz
691 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.4404703 GHz -12.46 dBm
D1 M1 1 1.042 MHz 1.39 dB
M2 1 2.4409913 GHz 8.30 dBm

CH78


Spectrum
Ref Level 21.50 dBm Offset 0.50 dB RBW 30 kHz
Att 40 dB SWT 63.2 µs VBW 100 kHz Mode Auto FFT
1Av Max
D1[1] 1.33 dB
1.04200 MHz
M1[1] -12.78 dBm
2.47947030 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
D1 -11.950 dBm
M1
M2
B1
CF 2.48 GHz
691 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.4794703 GHz -12.78 dBm
D1 M1 1 1.042 MHz 1.33 dB
M2 1 2.4799913 GHz 8.05 dBm

3.4 Channel Number (Number of Hopping Frequencies)

Minimum Number of Hopping Frequencies, FCC Rule 15.247(a) (1) (iii):

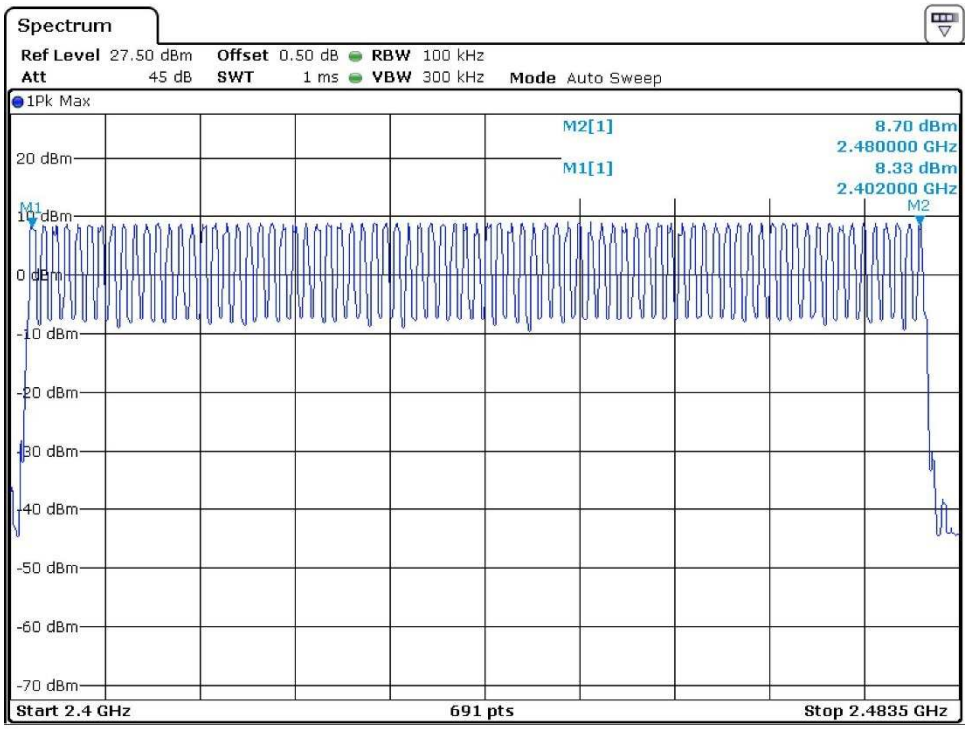
The RF passband of the EUT was divided into 3 approximately equal bands. With the analyzer set to MAX HOLD readings were taken for 2-3 minutes. The channel peaks so recorded were added together, and the total number compared to the minimum number of channels required in the regulation.

Number of hopping channels =	79

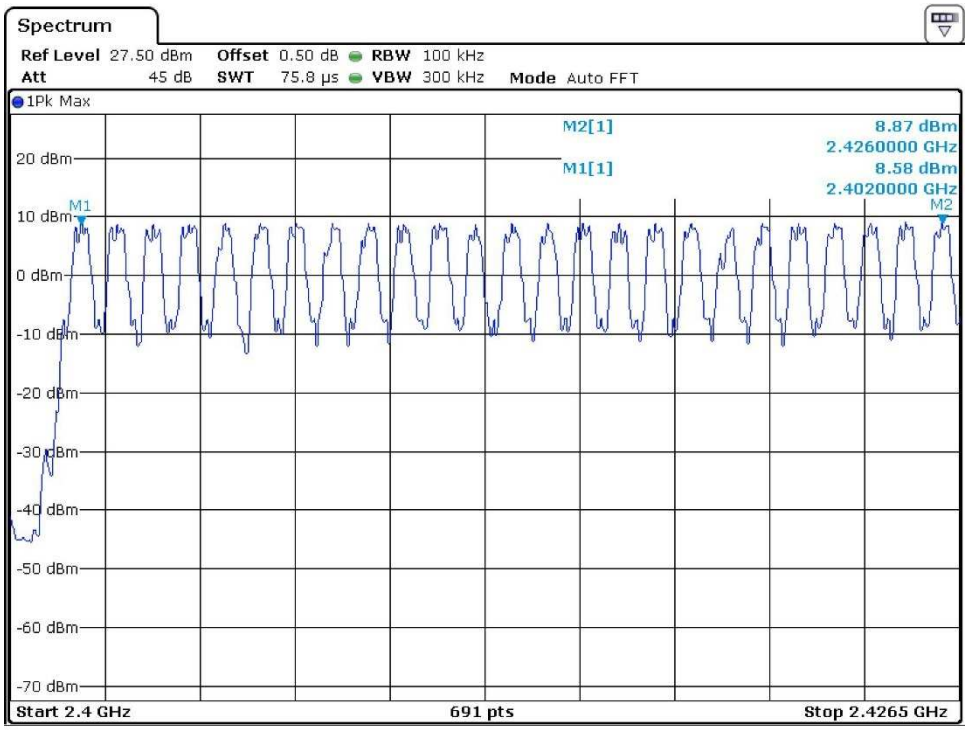
Note: In AFH mode, this device operates using 20 channels and it's satisfied the requirement of limit of minimum of 15 hopping channels.

Modulation Type: GFSK

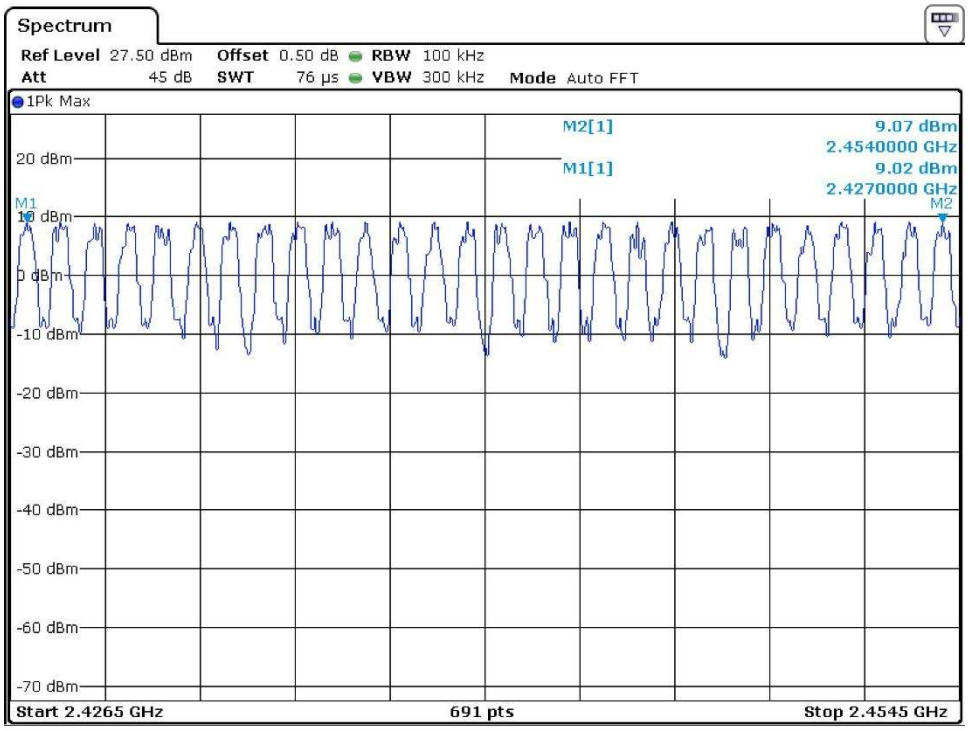
CH00-CH78



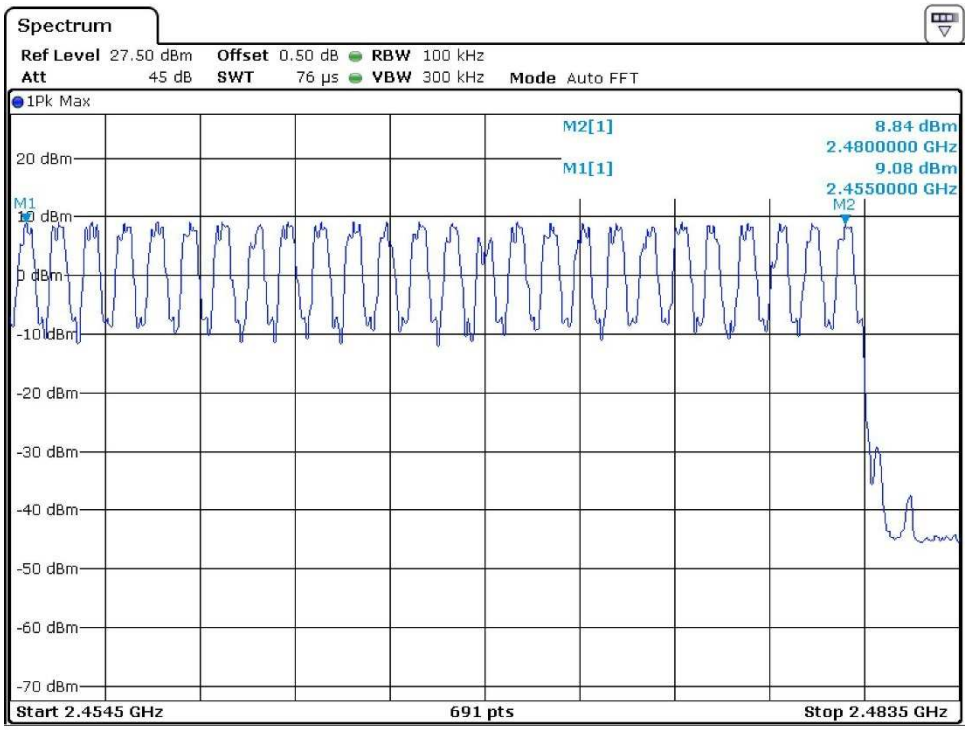
CH00-CH24



CH25-CH52



CH53-CH78


Spectrum
Ref Level 27.50 dBm Offset 0.50 dB RBW 100 kHz
Att 45 dB SWT 76 µs VBW 300 kHz Mode Auto FFT
1Pk Max
M2[1] 8.84 dBm
2.4800000 GHz
M1[1] 9.08 dBm
2.4550000 GHz
M1
M2
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
Start 2.4545 GHz
691 pts
Stop 2.4835 GHz

3.5 Channel Separation (Carrier Frequency Separation)

Minimum Hopping Channel Carrier Frequency Separation, FCC Ref: 15.247(a)(1):

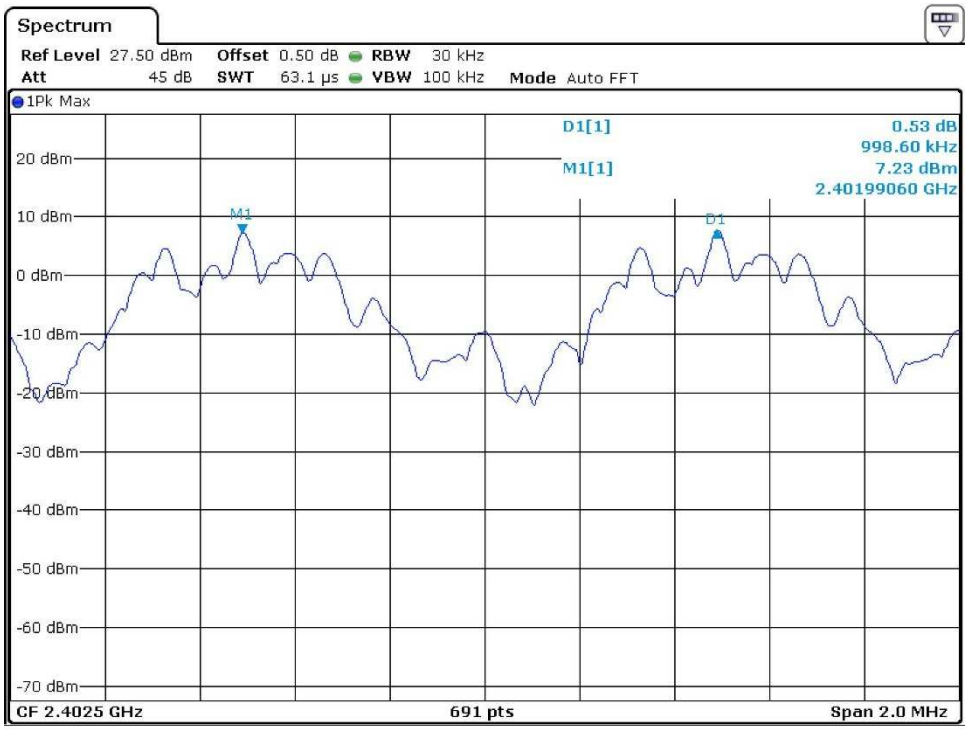
Using the DELTA MARKER function of the analyzer, the frequency separation between two adjacent channels was measured and compared against the limit:

Not less than 2/3 of 20dB bandwidth of hopping channel: 1.046 x 2/3 = 0.697MHz

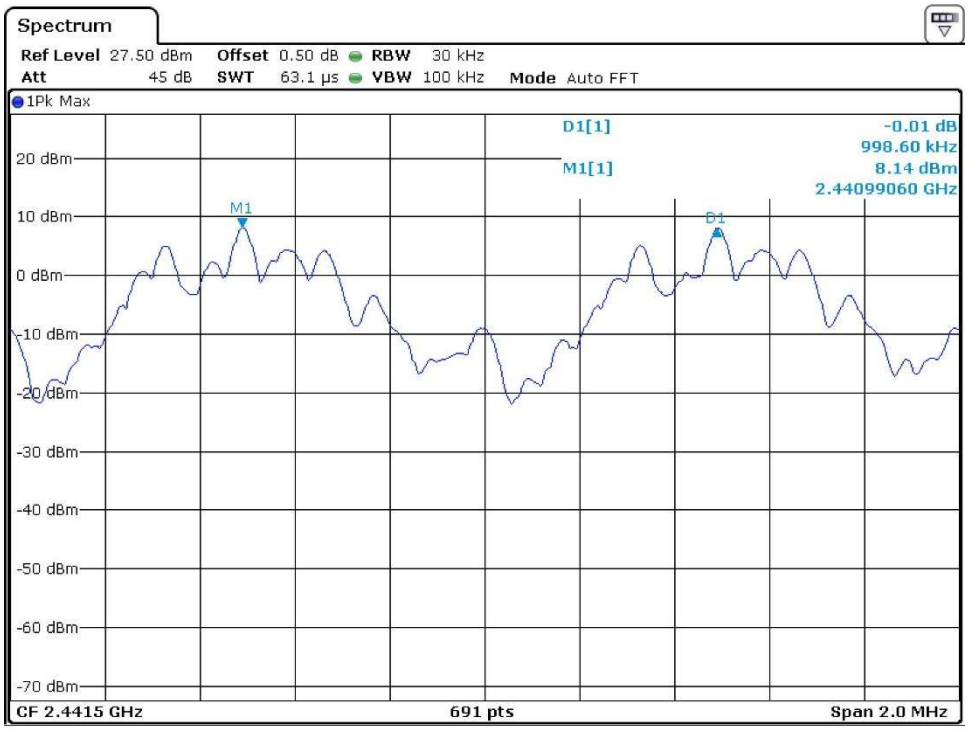
Minimum Channel Separation	0.9557 MHz

Modulation Type: 8-DPSK

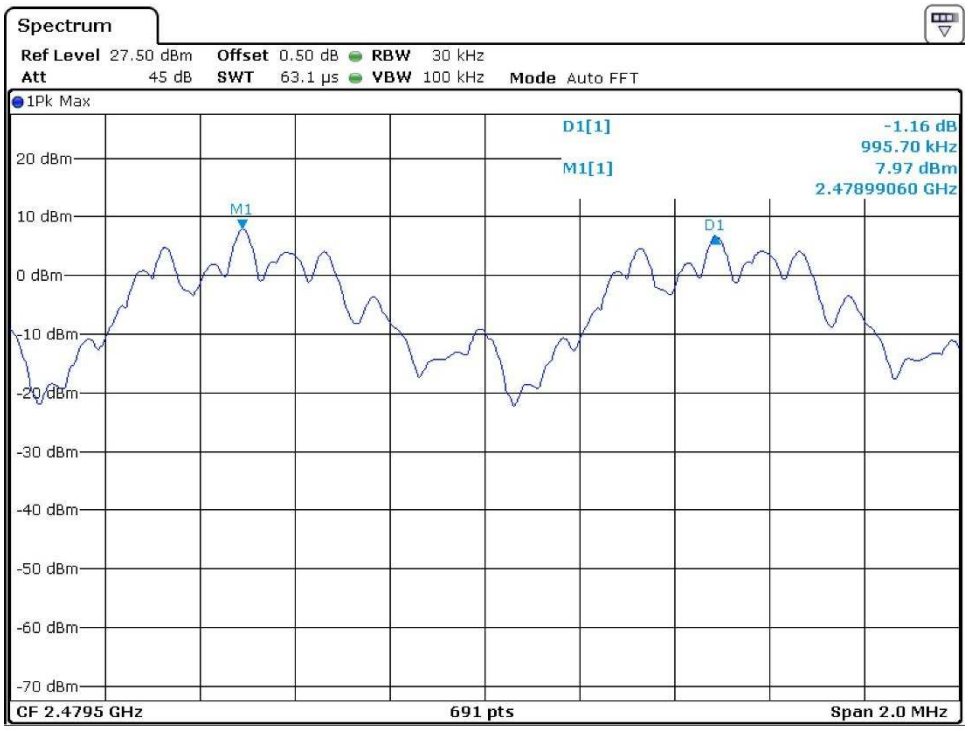
Low Channel



Middle Channel



High Channel



3.6 Dwell Time (Time of Occupancy)

Average Channel Occupancy Time, FCC Ref: 15.247(a) (1)(iii):

The spectrum analyzer center frequency was set to one of the known hopping channels with a longer sweep time to show two successive hops on a channel; the SPAN was set to ZERO SPAN, and the TRIGGER was set to VIDEO. RBW shall be ≤channel spacing and where possible RBW should be set >>1/T, where T is the expected dwell time per channel. The time duration of the transmissions so captured was measured with the MARKER DELTA function.

Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Different modes of operation were performed and only the worst case data was reported.

Worst Test Result:

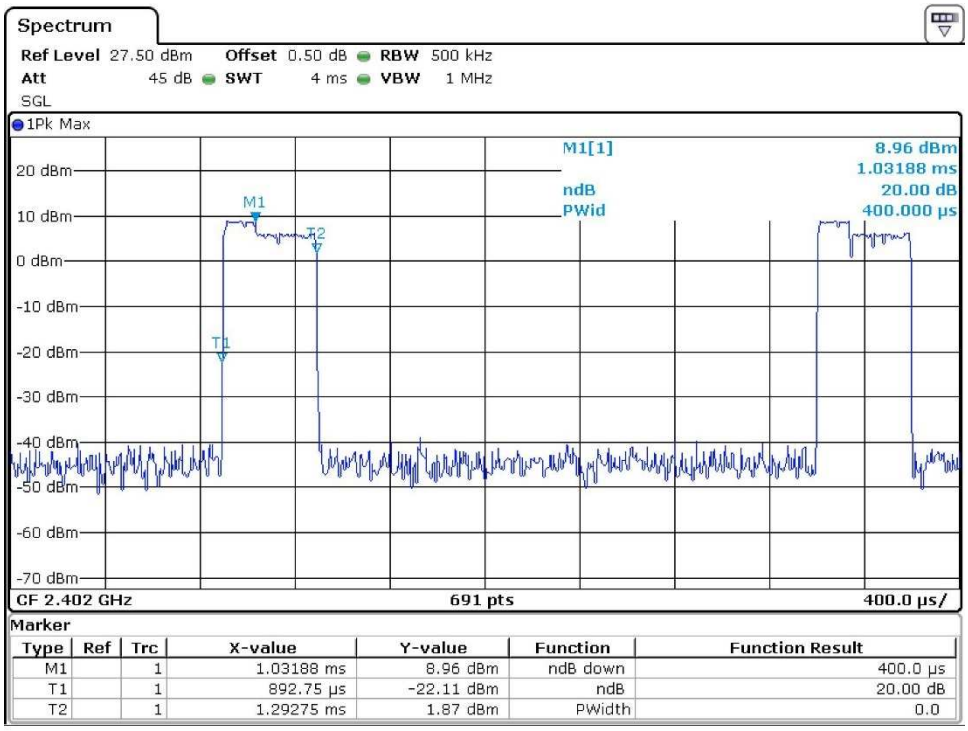
Normal hopping mode

Modulation Type	Packet	Max Dwell Time	Limit (s)	Result
8-DPSK	DH1	0.400ms * 116 = 46.4ms	0.4	Pass
	DH3	1.652ms * 120 = 198.24ms	0.4	Pass
	DH5	2.913ms * 110 = 320.43ms	0.4	Pass

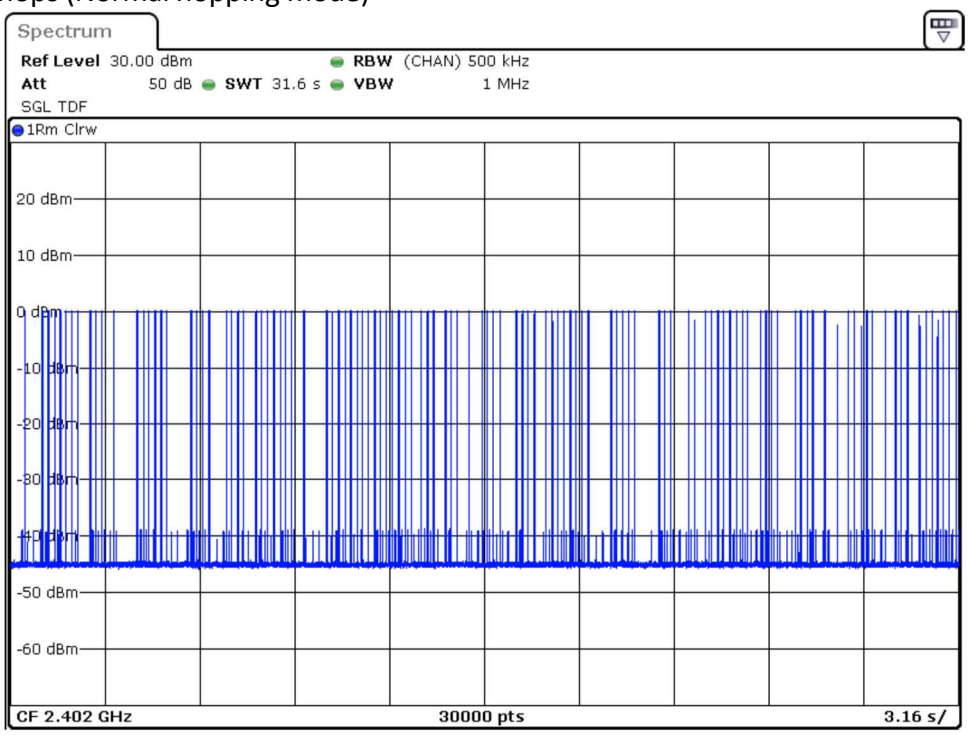
AFH mode:

Modulation Type	Packet	Max Dwell Time	Limit (s)	Result
8-DPSK	DH1	0.400ms * 45 = 18.00ms	0.4	Pass
	DH3	1.652ms * 34 = 56.168ms	0.4	Pass
	DH5	2.913ms * 32= 93.216ms	0.4	Pass

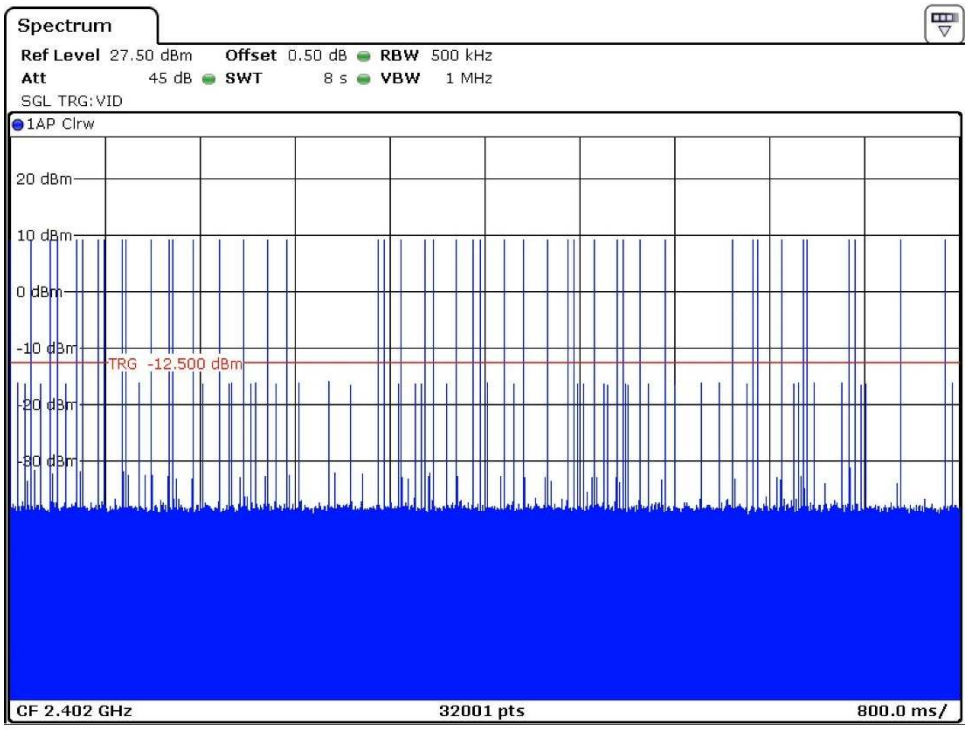
Modulation Type: 8-DPSK
Packet: DH1



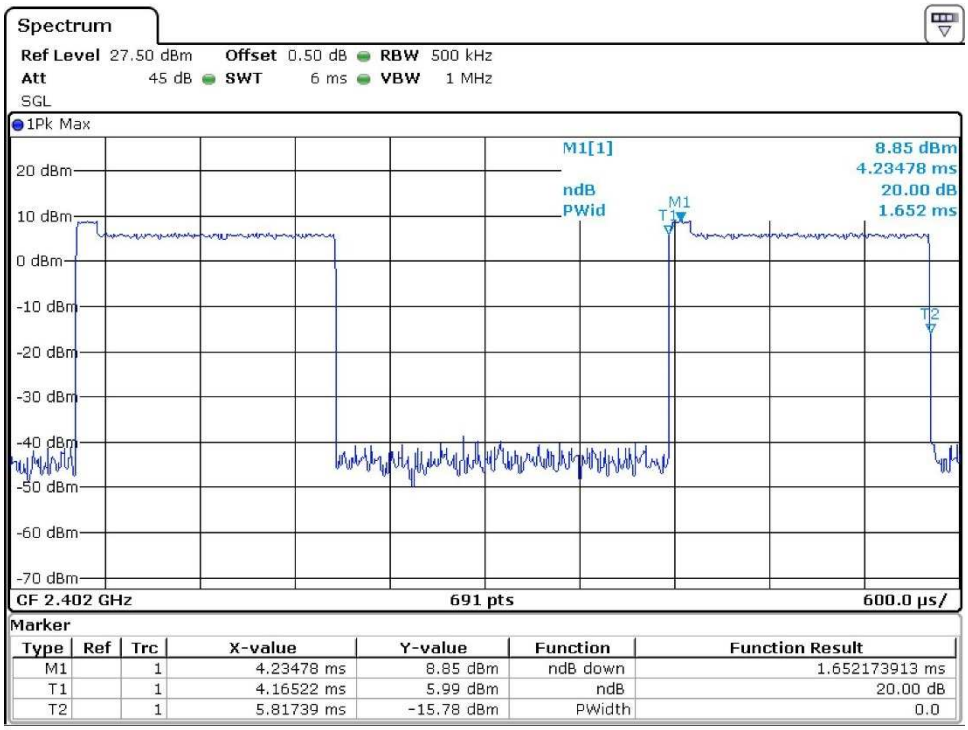
Number of hops (Normal hopping mode)



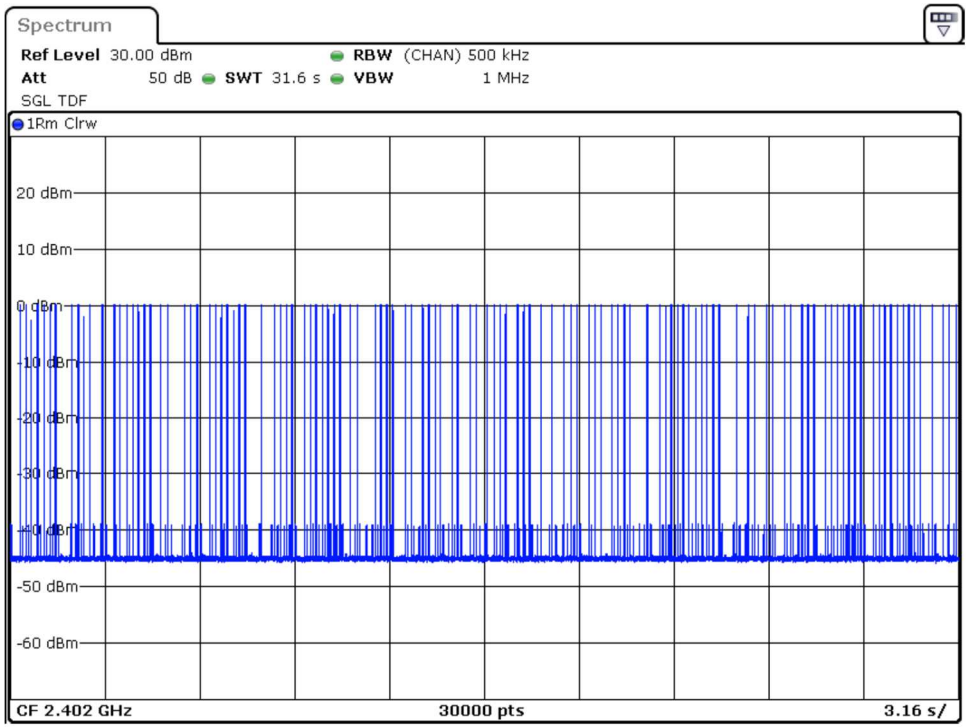
Number of hops (AFH mode)



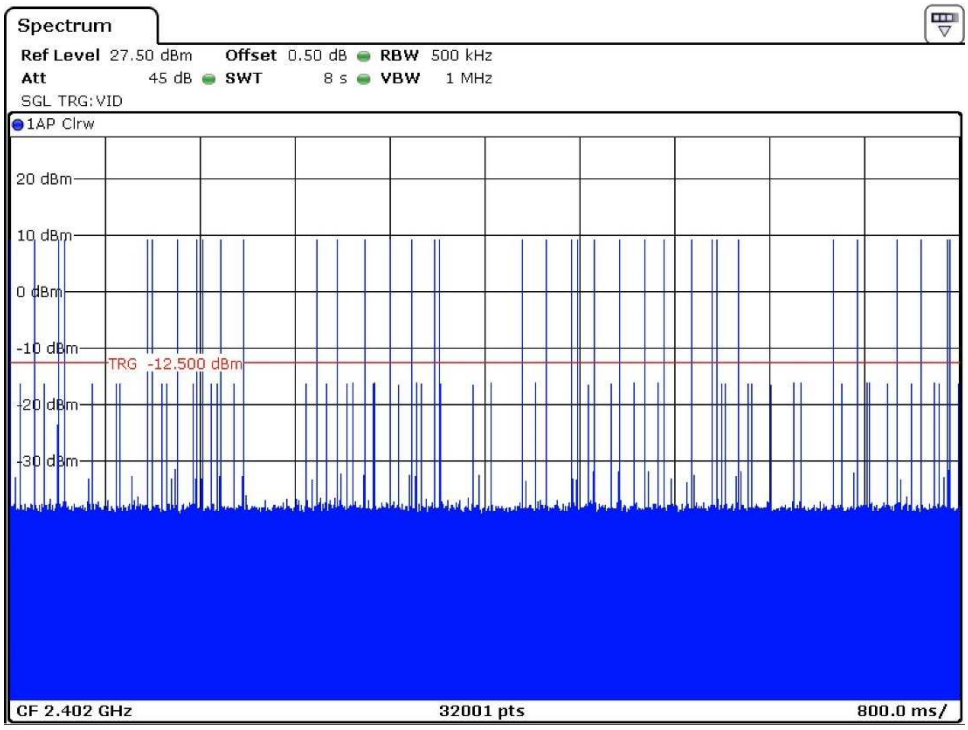
Packet: DH3



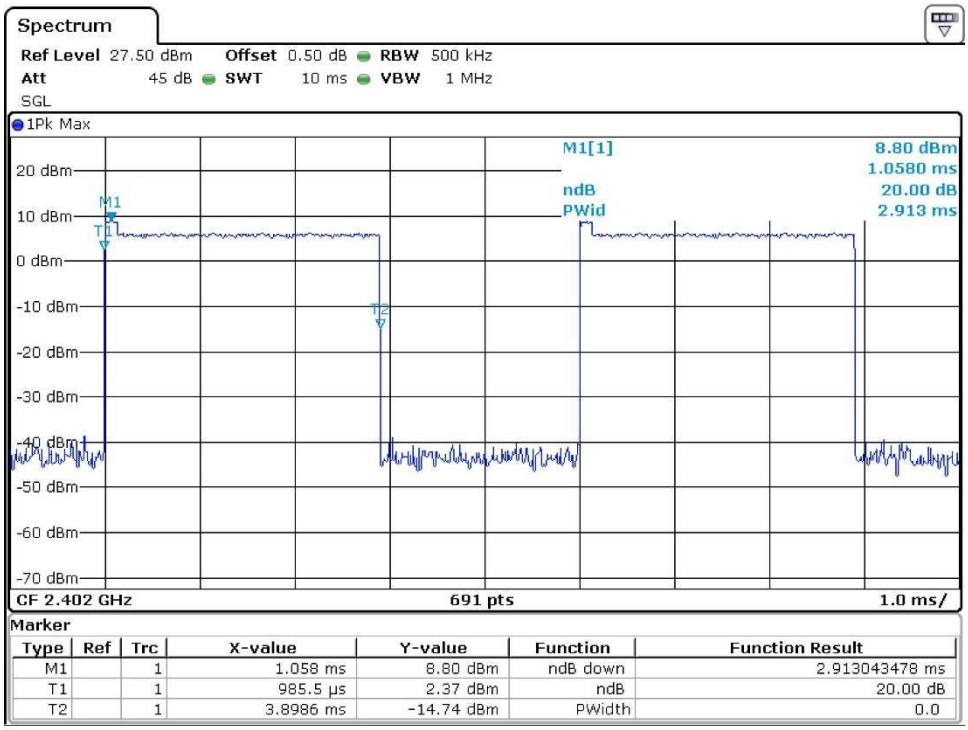
Number of hops (Normal hopping mode)



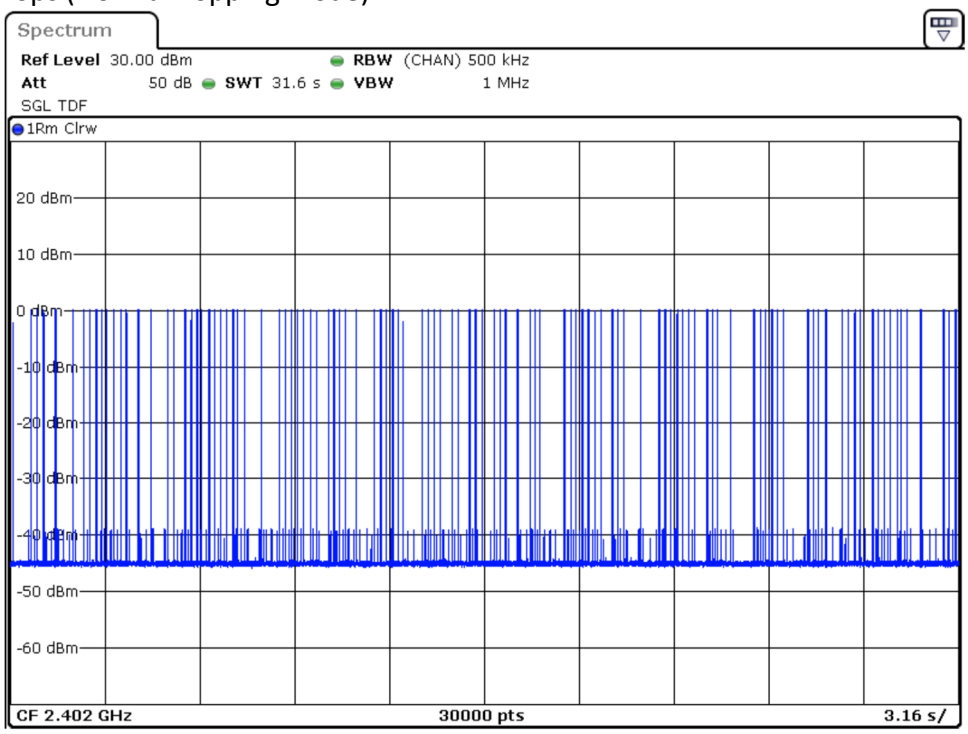
Number of hops (AFH mode)



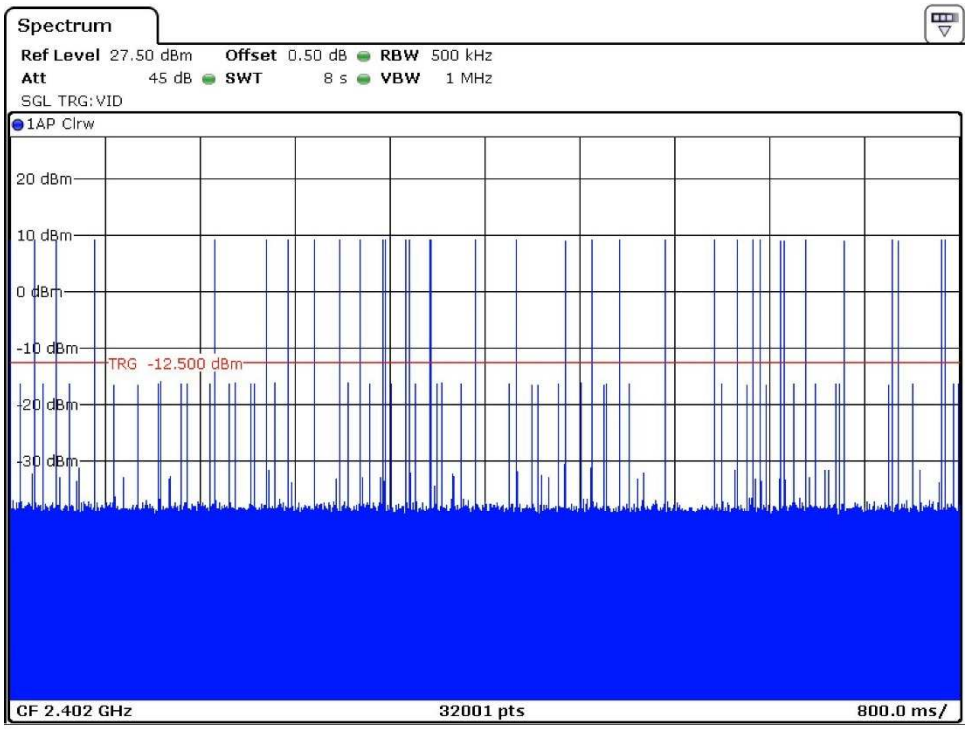
Packet: DH5



Number of hops (Normal hopping mode)



Number of hops (AFH mode)



3.7 Band Edge

Out of Band Conducted Emissions, FCC Rule 15.247(d):

In any 100 KHz bandwidth outside the EUT passband, the RF power produced by the modulation products of the spreading sequence, the information sequence, and the carrier frequency shall be at least 20 dB below that of the maximum in-band 100 kHz emission, or else shall meet the general limits for radiated emissions at frequencies outside the passband, whichever results in lower attenuation.

Furthermore, delta measurement technique for measuring bandage emissions was shown as below:

(i) Lower channel 2402.000MHz:

Peak Resultant field strength= Fundamental emissions (peak value) – delta from the bandedge plot
= 101.1 dBμV/m - 46.8 dB
= 54.3dBμV/m

Average Resultant field strength = Fundamental emissions (average value) – delta from the bandedge plot
= 78.6 dBμV/m - 46.8 dB
= 31.8dBμV/m

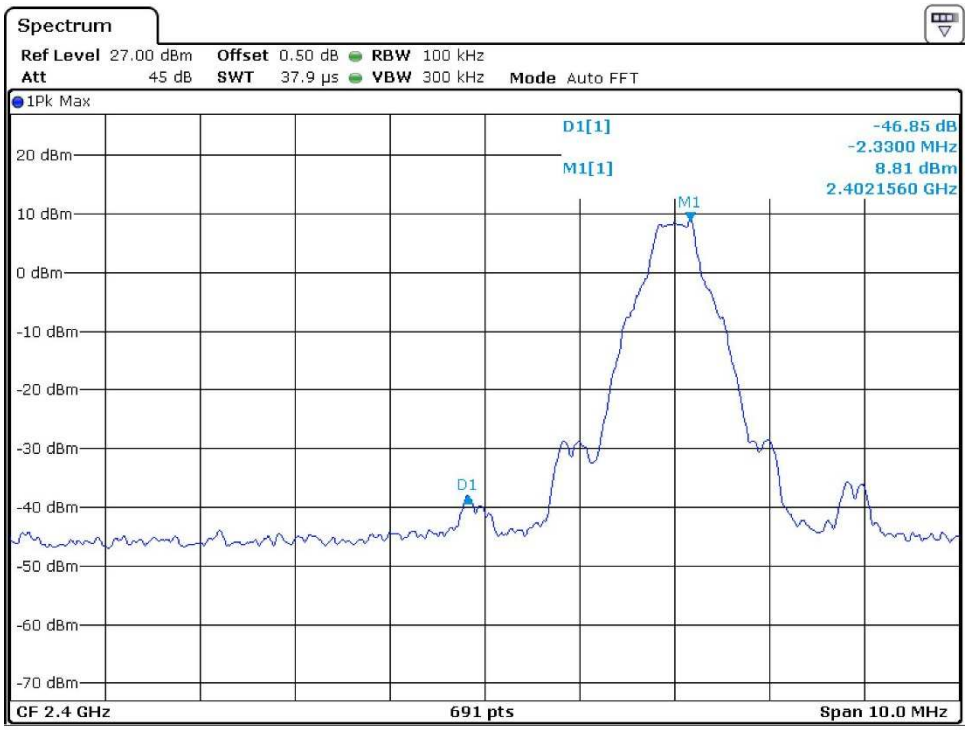
(ii) Upper channel 2480.000MHz:

Peak Resultant field strength= Fundamental emissions (peak value) – delta from the bandedge plot
= 99.9 dBμV/m - 51.3 dB
= 48.6dBμV/m

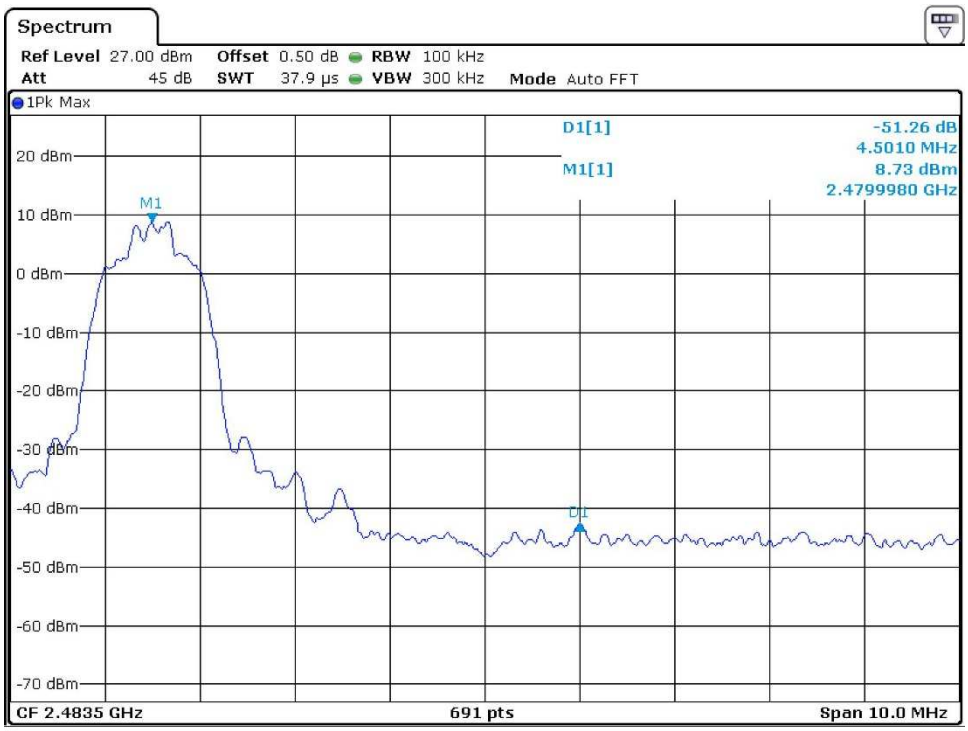
Average Resultant field strength = Fundamental emissions (average value) – delta from the bandedge plot
= 77.4 dBμV/m - 51.3dB
= 26.1dBμV/m

The resultant field strength meets the general radiated emission limit in section 15.209, which does not exceed 74dBμv/m (Peak Limit) and 54dBμv/m (Average Limit).

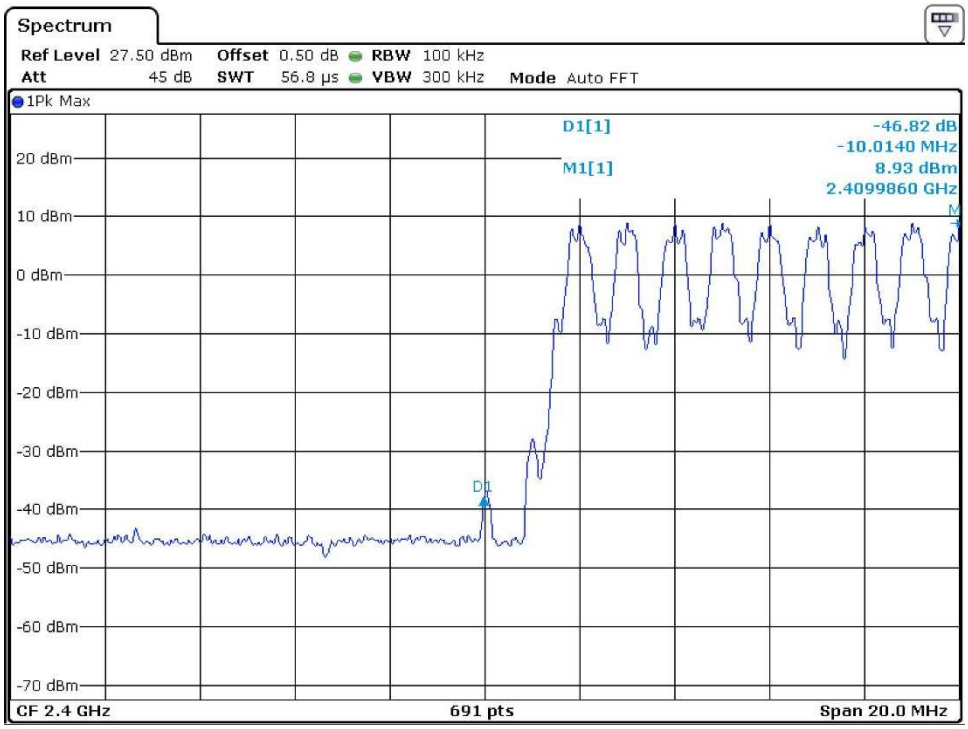
Modulation Type: GFSK
Single Channel



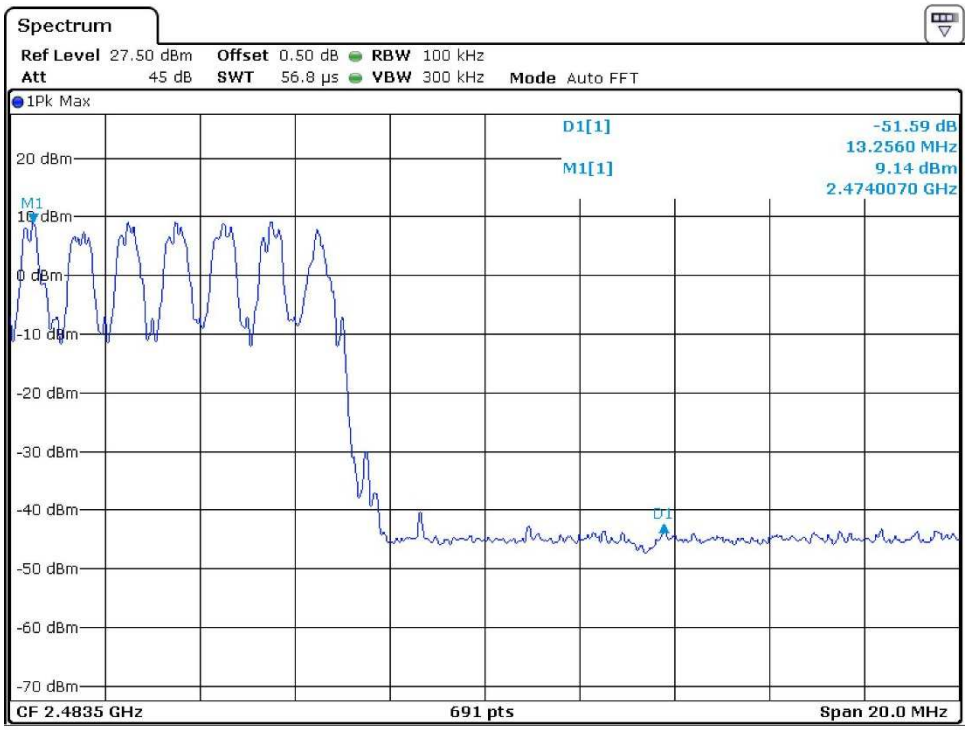
Single Channel



Hopping



Hopping



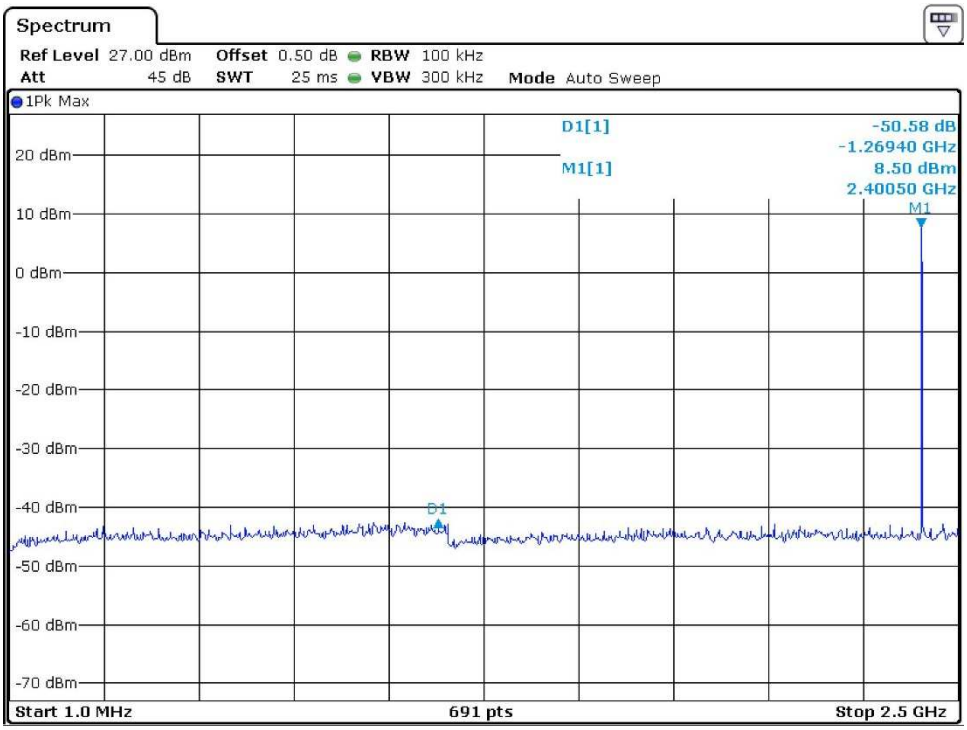
3.8 Transmitter Spurious Emissions (Conducted)

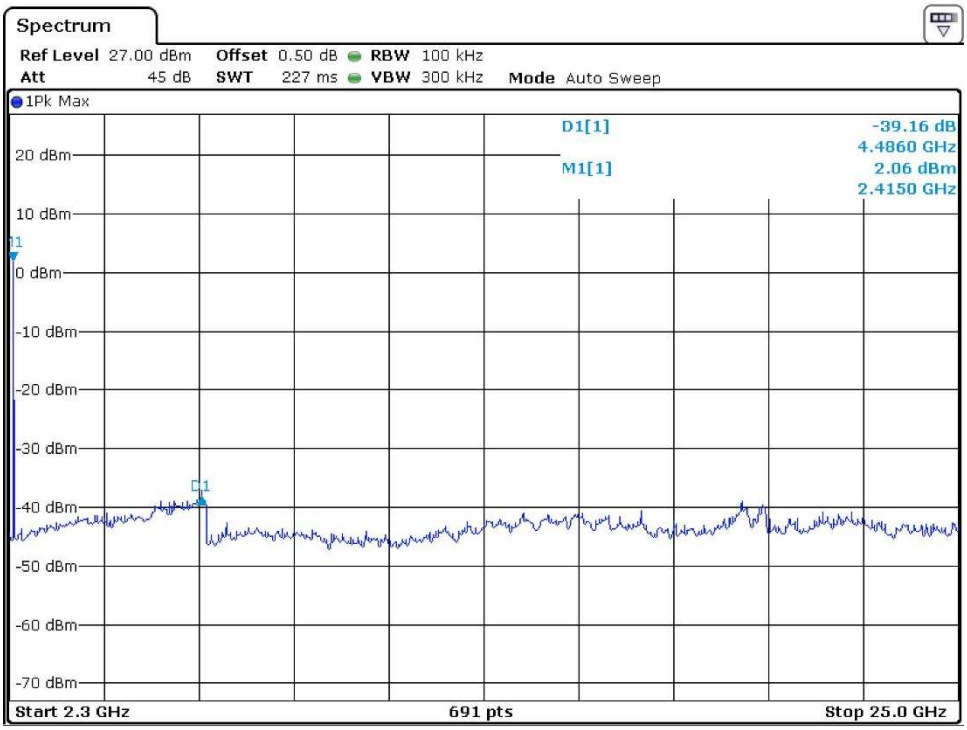
Out of Band Conducted Spurious Emissions, FCC Rule 15.247(d):

All spurious emission and up to the tenth harmonic was measured and they were found to be at least 20 dB below the highest level of the desired power in the passband.

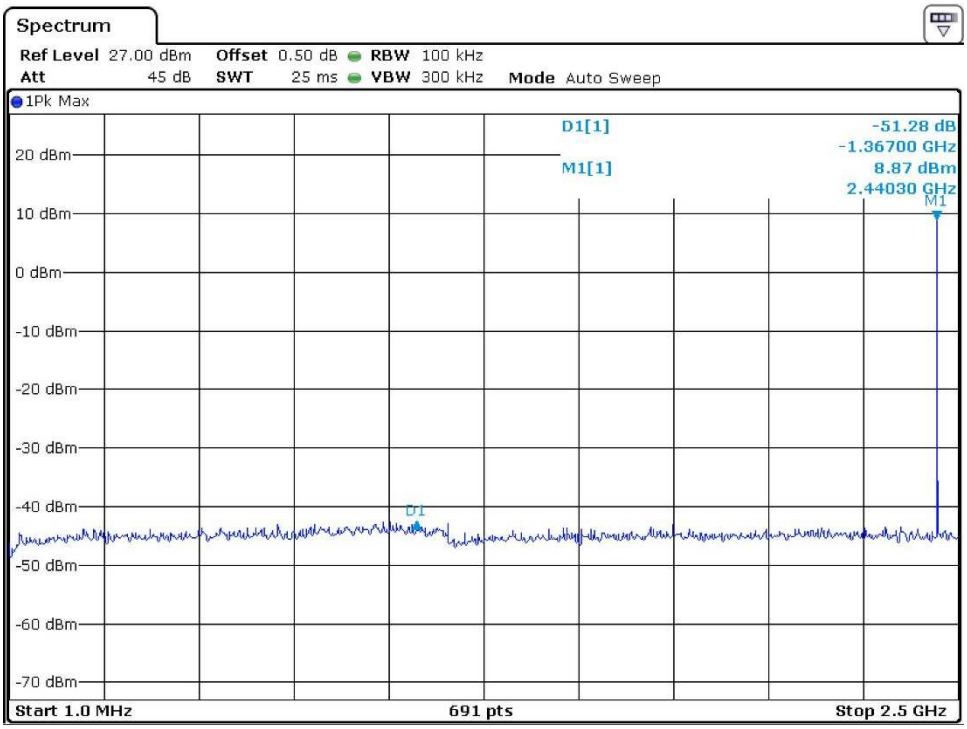
Modulation Type: π/4-DQPSK

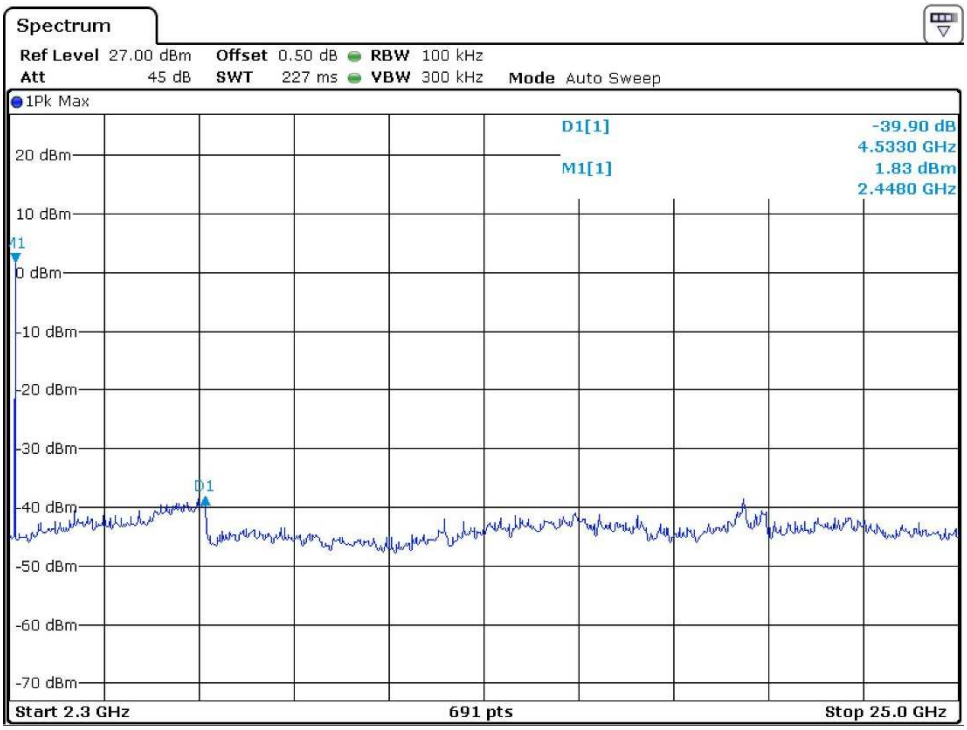
CH00



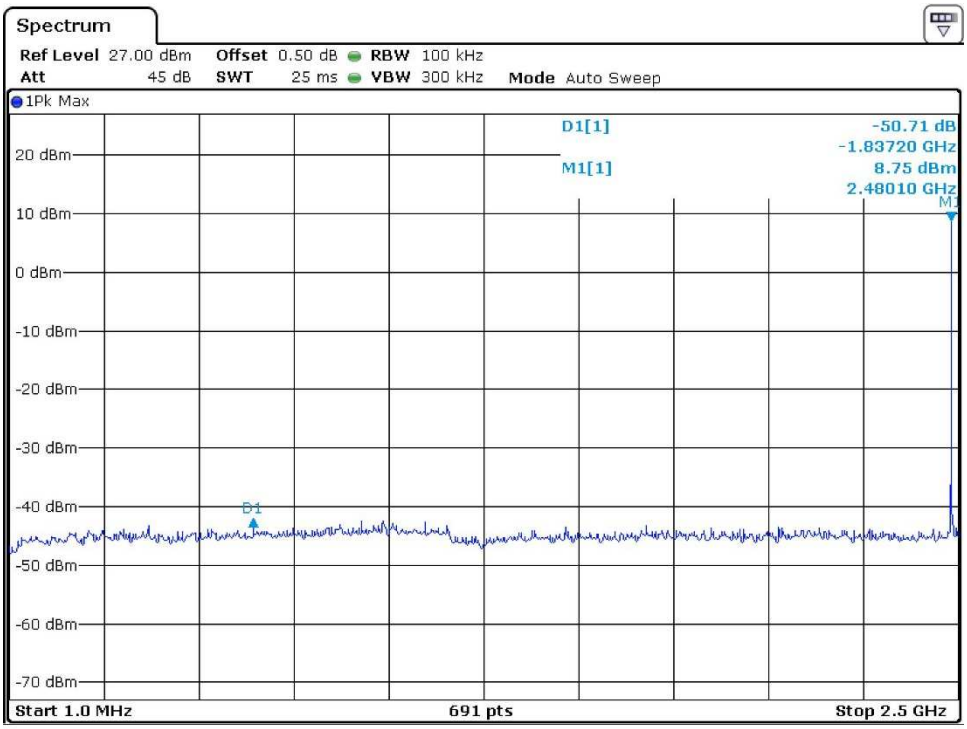


CH39


Spectrum
Ref Level 27.00 dBm Offset 0.50 dB RBW 100 kHz
Att 45 dB SWT 25 ms VBW 300 kHz Mode Auto Sweep
1Pk Max
D1[1] -51.28 dB
-1.36700 GHz
M1[1] 8.87 dBm
2.44030 GHz
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
Start 1.0 MHz
691 pts
Stop 2.5 GHz


Spectrum
Ref Level 27.00 dBm Offset 0.50 dB RBW 100 kHz
Att 45 dB SWT 227 ms VBW 300 kHz Mode Auto Sweep
1Pk Max
D1[1] -39.90 dB
4.5330 GHz
M1[1] 1.83 dBm
2.4480 GHz
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
Start 2.3 GHz
691 pts
Stop 25.0 GHz

CH78


Spectrum
Ref Level 27.00 dBm Offset 0.50 dB RBW 100 kHz
Att 45 dB SWT 25 ms VBW 300 kHz Mode Auto Sweep
1Pk Max
D1[1] -50.71 dB
-1.83720 GHz
M1[1] 8.75 dBm
2.48010 GHz
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
D1
M1
Start 1.0 MHz
691 pts
Stop 2.5 GHz

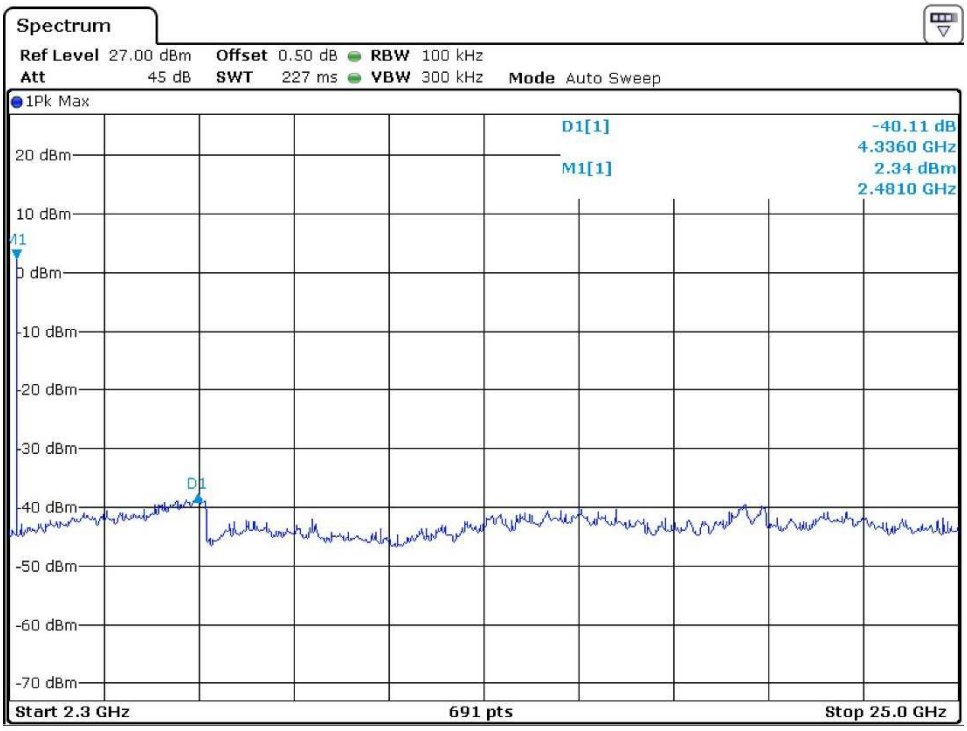

Spectrum
Ref Level 27.00 dBm Offset 0.50 dB RBW 100 kHz
Att 45 dB SWT 227 ms VBW 300 kHz Mode Auto Sweep
1Pk Max
D1[1] -40.11 dB
4.3360 GHz
M1[1] 2.34 dBm
2.4810 GHz
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
D1
Start 2.3 GHz
691 pts
Stop 25.0 GHz

EXHIBIT 4

EQUIPMENT PHOTOGRAPHS

4.0 Equipment Photographs

For electronic filing, the photographs of the tested EUT are saved with filename: external photos.pdf & internal photos.pdf.

EXHIBIT 5

PRODUCT LABELLING

5.0 Product Labelling

For electronic filing, the FCC ID label artwork and the label location are saved with filename: label.pdf.

EXHIBIT 6

TECHNICAL SPECIFICATIONS

6.0 Technical Specifications

For electronic filing, the block diagram and schematics of the tested EUT are saved with filename: block.pdf and circuit.pdf respectively.

EXHIBIT 7

INSTRUCTION MANUAL

7.0 Instruction Manual

For electronic filing, a preliminary copy of the Instruction Manual is saved with filename: manual.pdf.

This manual will be provided to the end-user with each unit sold/leased in the United States.

EXHIBIT 8

MISCELLANEOUS INFORMATION

8.0 Miscellaneous Information

This miscellaneous information includes details of the measured bandedge, the test procedure and calculation of factor such as pulse desensitization.

8.1 Discussion of Pulse Desensitization

Pulse desensitivity is not applicable for this device. The effective period (T_{eff}) is approximately 625μs for Bluetooth. With a resolution bandwidth (3dB) of 1MHz, so the pulse desensitivity factor is 0dB.

8.2 Transmitter Duty Cycle Calculation, FCC Rule 15.35 (b, c)

Based on the Bluetooth Specification Version 5.0, and worst case AFH mode, transmitter ON time is independent of packet type (DH5) and packet length, the AFH mode Duty cycle connection factor as below:

Channel hop rate = 800 hops/second (AFH Mode)
Adjusted channel hop rate for DH5 mode = 133.33 hops/second
Time per channel hop = 1 / 133.33 hops/second = 7.5 ms
Time to cycle through all channels = 7.5 x 20 channels = 150 ms
Number of times transmitter hits on one channel = 100 ms / 150 ms = 1 time(s)
Worst case dwell time = 7.5 ms
Duty cycle connection factor = 20log10(7.5ms / 100ms) = -22.5 dB

8.3 Emissions Test Procedures

The following is a description of the test procedure used by Intertek Testing Services in the measurements of transmitters operating under Part 15, Subpart C rules.

The test set-up and procedures described below are designed to meet the requirements of ANSI C63.10: 2013.

The transmitting equipment under test (EUT) is placed on a styrene turntable which is four feet in diameter, up to 1GHz 0.8m and above 1GHz 1.5m in height above the ground plane. During the radiated emissions test, the turntable is rotated and any cables leaving the EUT are manipulated to find the configuration resulting in maximum emissions. The EUT is adjust through all three orthogonal axes to obtain maximum emission levels. The antenna height and polarization are varied during the testing to search for maximum signal levels.

Detector function for radiated emissions is in peak mode. Average readings, when required, are taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings. A detailed description for the calculation of the average factor can be found in Exhibit 8.2.

The frequency range scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or 40 GHz, whichever is lower. For line conducted emissions, the range scanned is 150 kHz to 30 MHz with RBW 9KHz used.

8.4 Emissions Test Procedures (cont'd)

The EUT is warmed up for 15 minutes prior to the test.

AC power to the unit is varied from 85% to 115% nominal and variation in the fundamental emission field strength is recorded. If battery powered, a new, fully charged battery is used.

Conducted measurements are made as described in ANSI C63.10: 2013.

The IF bandwidth used for measurement of radiated signal strength was 10 kHz for emission below 30 MHz and 120 kHz for emission from 30 MHz to 1000 MHz. Where pulsed transmissions of short enough pulse duration warrant, a greater bandwidth is selected according to the recommendations of Hewlett Packard Application Note 150-2. Above 1000 MHz, a resolution bandwidth of 1 MHz is used (RBW 3MHz used for fundamental emission).

Transmitter measurements are normally conducted at a measurement distance of three meters. However, to assure low enough noise floor in the restricted bands and above 1 GHz, signals are acquired at a distance of one meter or less. All measurements are extrapolated to three meters using inverse scaling, but those measurements taken at a closer distance are so marked.

EXHIBIT 9

CONFIDENTIALITY REQUEST

9.0 Confidentiality Request

For electronic filing, the confidentiality request of the tested EUT is saved with filename: request.pdf.

EXHIBIT 10

TEST EQUIPMENT LIST

10 Test Equipment List

Equipment No.	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due Date
SZ061-12	BiConiLog Antenna	ETS	3142E	00166158	14-Sep-2018	14-Sep-2019
SZ185-01	EMI Receiver	R&S	ESCI	100547	4-Jan-2019	4-Jan-2020
SZ061-08	Horn Antenna	ETS	3115	00092346	14-Sep-2018	14-Sep-2019
SZ061-06	Active Loop Antenna	Electro-Metrics	EM-6876	217	21-May-2018	21-May-2019
SZ056-03	Spectrum Analyzer	R&S	FSP 30	101148	05-Jun-2018	05-Jun-2019
SZ056-06	Signal Analyzer	R&S	FSV 40	101101	05-Jun-2018	05-Jun-2019
SZ181-04	Preamplifier	Agilent	8449B	3008A02474	15-Jan-2019	15-Jan-2020
SZ188-01	Anechoic Chamber	ETS	RFD-F/A-100	4102	15-Dec-2018	15-Dec-2020
SZ062-02	RF Cable	RADIALL	RG 213U	--	10-Jun-2018	10-Jun-2019
SZ062-05	RF Cable	RADIALL	0.04-26.5GHz	--	10-Jun-2018	10-Jun-2019
SZ062-12	RF Cable	RADIALL	0.04-26.5GHz	--	10-Jun-2018	10-Jun-2019
SZ067-04	Notch Filter	Micro-Tronics	BRM50702-02	--	05-Jun-2018	05-Jun-2019

********** End of Report**********